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TRADE POLICIES AND PRODUCTIVITY CHANGE IN SEMI-INDUSTRIALIZED COUNTRIES

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The role of trade policies in increasing growth and efficiency has long been a major focus in the development literature. This paper examines the impact of different development strategies, especially export expansion and import substitution trade policies, on total factor productivity growth in the manufacturing industries. The analysis is based on recently developed data on sectoral total factor productivity in Korea, Turkey, and Yugoslavia, with Japan as a comparator. Our results indicate that there are important links between trade policies and industrial productivity performance.

1. Introduction

Total factor productivity (TFP) measures the economic and technical efficiency with which resources are converted into products. The growth of an economy, an industry, or a firm is determined by the rate of expansion of its productive resources and the rate of TFP growth. In the case of developing countries, there are all sorts of constraints and limits to how fast employable resources can grow. Achieving rapid rates of TFP growth is then a real issue in breaking bottlenecks. Furthermore, an important part of the 'catching up' process involves exploiting changing comparative advantage. In which activities and how quickly, can international competitiveness be achieved? Differential sectoral rates of TFP growth are crucial determinants of evolving comparative advantage and have a major impact on both growth and structural change in the medium to long run.

There are two issues concerning TFP growth that are expecially relevant for development policy. First, what is the range of TFP growth rates one can reasonably expect? Confidence intervals for TFP growth rates can, in principle, be obtained from historical records of firms, industries, or

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economies operating under varying production environments. They provide useful information for determining, for example, the appropriate duration of infant industry protection or promotion policies. Is five years too short? Twenty years too long? Should the duration be uniform among industries, or should they differ from industry to industry? The second issue of policy relevance has to do with the cause or sources of TFP growth. For example, does protection from competing imports destroy incentives for improving efficiency in production? Can some policies improve productivity — for example, subsidies tailored to specific factors such as fiscal incentives for accelerated depreciation, employee training subsidies, etc.?

The empirical literature on TFP change has, over the years, accumulated a substantial body of 'stylized facts' about the contribution of productivity change and factor input growth to economic performance in various countries.[1] Perhaps the most significant stylized fact that has emerged is the importance of TFP change in contributing to growth — as much as one-third to one-half of growth in output can be attributed to TFP change. Until quite recently, much of what we knew was in terms of macro aggregates.[2] There is now, however, a small but growing empirical literature on TFP change at a disaggregated level.[3] The first objective of this paper is to add to this body of 'stylized facts' based on recent time-series data developed at the World Bank on TFP growth at the sectoral level within manufacturing for three countries: Korea, Turkey, and Yugoslavia. We add Japan to the sample as a comparator based on data developed by Jorgenson and Nishimizu (1981).

In contrast with the growing stock of empirical estimates of TFP growth, we have not accumulated sufficient evidence about causes of productivity change. As surveyed and discussed extensively by Nelson (1981), the literature on productivity change offers a wide variety of possible causes, but without any clear consensus as to where one should focus most attention. In the development literature, the role of trade policy in increasing growth and efficiency has long been a major focus. The second, and more important,

[1]For a review of the literature, see Nadiri (1970, 1972). For an excellent critical survey of the productivity literature, see Nelson (1981).

[2]See, for example, Christensen and Jorgenson (1973), Christensen, Cummings, and Jorgenson (1980), Denison (1967, 1974), Denison and Chung (1976), Ezaki and Jorgenson (1973), and Griliches and Jorgenson (1967), for studies on developed countries. On developing countries, Christensen, Cummings, and Jorgenson (1980) included Korea in their international comparison, Bruton (1967), and Elias (1978) studied Latin American countries. See also Robinson (1971) and Feder (1983), and studies cited by them, as well as by Nadiri (1972).

[3]See, for example, Kendrick (1961, 1973) and Gollop and Jorgenson (1980) for the United States, Nishimizu and Hulten (1978) Kuroda and Imamura (1981) for Japan, and a comparative study of the U.S. and Japan by Jorgenson and Nishimizu (1981). In addition, there are productivity studies of regulated industries or firms in the U.S. and Canada. See, for example, Cowing and Stevenson (1981). A comprehensive study of Indian manufacturing industries was made recently by Ahluwalia (1982). See also Ezaki (1975) on the Philippines, Kuo (1983) on Taiwan, and Kim and Son (1979) on Korea.

objective of this paper is to examine the impact of different development strategies, especially trade policies, on sectoral TFP growth. Our analysis is exploratory and considers a number of hypotheses that have been suggested over the years. There is certainly no shortage of hypotheses. Indeed, it is difficult to sort out the differences among them and to define the appropriate measures and tests required to address them. Our analysis does indicate that there are important links between trade policies and productivity performance, and raises a number of issues for further research.

One hypothesis which has been suggested in the literature is that there is a positive relationship between productivity change and the rate of growth of output. Expressed in terms of labor productivity, this effect has been called 'Verdoorn's law' after P.J. Verdoorn who suggest it in 1949. A number of people have investigated the relationship and Kaldor (1967) has argued that the fundamental explanation for it is scale economies.[4] He noted further that it is observed most prominently in manufacturing and other secondary industrial activities. In developing countries, the importance of scale economies and 'size of market' have long been thought to be very important in determining growth and structural change.[5] The existence of scale economies, or any other justification for Verdoorn's law, implies that widening the market through trade should lead to reductions in production costs. The argument is usually made in terms of the benefits of expansion in demand through increased exports. Although it depends on the size of domestic markets, the argument should in principle apply to import substitution as well.

A quite different trade-policy argument is that opening up to international competition will induce increases in domestic efficiency. There is an implicit 'challenge-response' mechanism induced by competition, forcing domestic industries to adopt new technologies, to reduce 'X-inefficiency', and generally to reduce costs wherever possible. According to this argument, export expansion is good, and so too is important liberalization. While a policy of increasing imports may restrict the market for domestic goods, it also increases competition and hence induces greater efficiency. The converse is also widely asserted; protectionist policies designed to promote import substitution reduce competitiveness and lead to inefficiency in production. One must be careful not to overstate the argument. 'Infant industry' protection, by definition, is afforded to high cost industries which cannot compete with imports until they 'grow up' and become internationally competitive. Conversely, export promotion policies such as excessive export subsidies may distort incentives and lead to increasing inefficiency. It is important to focus on the causal mechanism assumed to be working: export expansion and import substitution policies may increase or decrease TFP

[4]See also Salter (1960) and Kaldor (1961).

[5]See Chenery and Westphal (1979) and Balassa (1967).

(levels and/or growth rates) depending on their impact on competitive, cost-reducing incentives to producers in the medium to long run.

The literature on foreign exchange constraints provides yet another argument for a link between trade and productivity. A stylized fact characterizing developing countries is that intermediate and capital goods imports are not very substitutable with domestically produced goods. In a sense, these imported inputs embody technologies that are unavailable to domestic producers and can only be attained through imports. Any policies that limit the availability of such imports, or make them more expensive, will lead to poor productivity performance. Conversely, policies which increase the availability of imported inputs, or lower their cost, (e.g., increased foreign aid or an export-led development strategy) will lead to cost reductions to domestic industries, and hence to better productivity performance. In this view, exports are important only as a source of foreign exchange, permitting industries to buy inputs which can be produced domestically only at much higher, if not infinite, cost.

It is important to note that these hypotheses about possible links between alternative development strategies distinguished by trade policies and TFP growth are not mutually exclusive. They may all be true, and the postulated effects also need not be independent of one another. Given the current state of knowledge, it is simply not possible to discriminate finely among them. Indeed, it is not even possible to state with any real confidence what is the direction of causation. It is just as likely, for example, that 'exogenous' TFP growth in a sector generates a shift in the supply curve and hence, if domestic demand is limited, a strong incentive to open up export markets. The possible relationships are myriad, and will probably have to be sorted out on a case-by-case basis.

In this paper, we begin by looking at the historical experience of four countries and try to sort out similarities and differences among them at the sectoral level. We then explore some of the hypotheses discussed above, using additional data on the nature of the development process in the countries. The four countries, at various times, have pursued a variety of development strategies and supporting trade policy regimes. This variety yields experiments in which different effects dominate the results, and enables us to explore the relative importance of factors such as import substitution versus export expansion. Before considering the empirical results, however, we first discuss the nature of TFP measures we use. The measures embody a number of strong assumptions that affect how they should be interpreted, and what they capture as productivity change.

2. The analytical framework for TFP measurement

The analytical framework for TFP measurement is founded on the economic theory of cost and production. In recent decades, developments in the field of productivity research have been accompanied by advances in closely related areas of economic theory and measurement. They include duality theory, theory of index numbers, and the development of flexible functional forms which are less restrictive in representing economic relationships such as production functions and cost functions.[6] Advances in these areas have strengthened the theoretical foundations of TFP measurement.[7]

Indices of TFP change are usually given in terms of output per unit of total factor inputs, and are functions of scale elasticities, output and input elasticities, and quantities (or prices) of outputs and inputs. It is usually assumed that output and input markets are competitive, and that firms maximize profit subject to a constant returns to scale production function and market prices which are taken as parameters. Under these assumptions, output and input elasticities are equivalent to the observed cost shares of factor inputs and revenue shares of each output produced.[8] The index of TFP change can then be computed using only the prices and quantities of outputs and inputs, and equals the difference between revenue share weighted output growth rates and cost share weighted input growth rates. There is an extensive literature on the choice of an 'appropriate' index of TFP change.[9] Essentially, one must specify something about the form of the production function (or, alternatively, the cost function) in order to justify a particular form of an index. We chose the translog production function and the resulting translog index number in our methodology.[10]

This framework for TFP measurement has a number of shortcomings. The simple stylization of production and markets ignores a number of factors and constraints that may be important. Nelson (1981), in his recent review of the productivity literature, provides a detailed criticism and evaluation of the approach. A couple of issues he raises are worth emphasizing since they affect the interpretation of our empirical results.

A production process can be seen as the application of 'technology' to the production of goods and services. Technology, however, represents more

[6]Caves, Christensen, and Diewert (1981, 1982a, b) provide a good and concise summary of the literature and references. See also Gollop and Jorgenson (1980).

[7]In this section, we shall provide a brief exposition of the analytical framework. For a more detailed and technical discussion, see some of the references cited above.

[8]When these assumptions are not tenable — as in Yugoslavia — direct estimates of output and input elasticities and scale elasticities must be generated. See Nishimizu and Page (1982).

[9]For a survey on the theory of index numbers, see Diewert (1979).

[10]For a detailed exposition of this approach, see Diewert (1976) for a theoretical discussion, and Gollop and Jorgenson (1980) for applications. There is an issue of whether one should work with a value added production function (excluding intermediate input) or with a gross production function (including intermediate input). We chose the gross production function approach in this paper, since we believe that intermediate inputs 'matter' in sectorial TFP change, and that it is misleading to assume that intermediate inputs are separable from capital and labor. There is an extensive literature on this issue, but the most comprehensive treatment can be found in Gollop and Jorgenson (1979). Gollop and Jorgenson (1979) also provide a comprehensive treatment and survey of the literature on aggregation over sectoral TFP estimates and the impact of intersectoral resource shifts on TFP change at the macro level.

than simply machines, tools, and equipment. It may be embodied in workers and managers, physical characteristics of material inputs, or in procedures and organizational principles that determine how various inputs are combined. It may also be embodied in produced outputs themselves. As Nelson discusses at length, TFP changes may therefore result from all sorts of changes in this broadly interpreted 'technology' applied to production.

Nelson also points out that production takes place within 'production environments', defined by the nature of markets for inputs and outputs, and by a set of market and nonmarket constraints such as government policies. Changes in production environments ultimately affect productivity performance by altering production constraints via changes in prices, quantities, or qualities of inputs and outputs. They may also have important shorter-run impacts on TFP changes during the process of adjustment to new conditions in production environments.

Thus, our empirical results on TFP change should not be interpreted as measuring only 'technical change' in the sense of a shift in the production possibility frontier due to the implementation of 'new generation of technical knowledge'. Instead, the measures must be interpreted quite broadly, and include such issues as industrial and plant organization, engineering know-how, or changes due to disruptions in the production process that affect capacity utilization in the relatively short run. The measures really treat production units as a black box. We measure the inputs and the outputs, but make no real attempt to describe exactly what is going on inside the plant gate. Figuring out how the black box works is important, but is beyond the scope of the present paper.[11] We seek to delineate the stylized facts at a fairly aggregate level, and will necessarily be modest in our attempts to generalize and to discern causal links.

3. Growth and productivity change in the manufacturing industries

In this section, we attempt to distinguish systematic patterns of output, input, and TFP growth in manufacturing industries of Japan, Korea, Turkey, and Yugoslavia. The historical period we consider is from the late 1950s/early 1960s to the early/late 1970s. One common characteristic that unites the development experiences of these four countries during the period is that they are all semi-industrialized countries, with Japan graduating to industrialized status sometime during the 1960s. Among the four countries, however, there is a variety of different development strategies and supporting trade policy regimes. If factors related to stage of development or trade policy have a significant impact on productivity performance, we should be

[11]See Nelson (1981) for a survey of the relevant literature. Research towards this objective is under way at the World Bank, in two research projects: *Acquisition of Technological Capability* (RPO 672-48) by Carl Dahlman and Larry Westphal, and *Productivity Change in Infant Industries* (RPO 672-86) by Mieko Nishimizu and John M. Page, Jr.

able to see systematic similarities and differences among the four countries which are indicative of their influence.

Our empirical analysis is based on Japanese data developed by Jorgenson and Nishimizu (1981), and data recently developed at the World Bank on TFP growth in manufacturing industries in Korea, Turkey, and Yugoslavia.[12] To summarize, data on gross output, labor, capital, and material input in current and constant prices were assembled for the manufacturing industries in these four countries.[13] Conceptually similar methodologies were used in defining the variables and in aggregate to achieve comparability.[14] Gross output and material input by industry are in constant 1970 prices in each country. Capital is defined as net capital stock at replacement cost in 1970 prices and includes all non-residential structures and producers' durables. Land and inventories unfortunately could not be included due to data unavailability in the developing countries. Labor is defined as persons employed — data on hours worked are not readily available in the three developing countries. The summary of industry estimates on which our analyses are based are presented in appendix tables A.1 and A.2.[15]

In an essay on economic growth, Kaldor stated (with empirical support) that 'fast rates of growth are almost invariably associated with the fast rate of growth of the secondary sector, mainly manufacturing, and... this is an attribute of an intermediate stage of development'.[16] Table 1 presents average annual growth rates of TFP, gross output, and capital, labor, and material input, as well as the standard 'sources of growth' decomposition, for aggregate manufacturing in Korea, Turkey, Yugoslavia and Japan. These countries all demonstrate rapid growth in manufacturing, and seem to fit Kaldor's stylization of being at an 'intermediate stage' of development. Fig. 1 plots output growth rates of different industries for each country (from table A.1), along with the sample mean and sample standard deviation. The figure shows that the rapid manufacturing growth in these countries is the result of many industries growing 'uniformly' fast. Over two-thirds of all industries have growth rates in the range 9 to 15 percent in Japan, 17 to 27 percent in

[12]The data come from two World Bank research projects: *Sources of Growth and Productivity Change: A Comparative Analysis*, and *Productivity Change in Yugoslavia.* More detailed discussions of the results are available in separate papers. See Krueger and Tuncer (1980) on Turkey, Rhee (1980) on Korea, Nishimizu and Page (1982) on Yugoslavia, and Nishimizu and Robinson (1983) for a more comprehensive treatment of the four country comparisons.

[13]Data for Korea include 52 manufacturing industries, for Turkey 33 industries, for Yugoslavia 19 industries, and for Japan 21 industries. For the purpose of this paper, we aggregated these data for each country to sixteen comparable sectors (roughly the ISIC two-digit classification).

[14]The methodology for Yugoslavia differs from the others because one could not assume that cost-share data reflected the workings of a competitive market [see Nishimizu and Page (1982)].

[15]Table A.1 shows the average annual growth rates of TFP, gross output, and capital, labor, and material input. Table A.2 gives the standard 'sources of growth' decomposition in terms of the share of TFP change and growth of each input in gross output growth.

[16]Kaldor (1967, p. 7).

Table 1
Sources of growth for the manufacturing sector (percent per year).

	Japan 1955–73	Korea 1960–77	Turkey 1963–76	Yugoslavia 1965–78
(1) Gross output	11.59	17.94	10.71	9.78
(2) Capital input	10.84	12.98	11.24	7.72
(3) Labor input	4.50	5.32	5.05	2.99
(4) Material input	10.41	16.29	9.29	11.55
(5) Weighted capital input[a]	1.51 (0.130)	3.50 (0.195)	3.23 (0.302)	0.78 (0.080)
(6) Weighted labor input[a]	0.70 (0.060)	0.46 (0.026)	0.55 (0.051)	0.67 (0.069)
(7) Weighted material input[a]	7.34 (0.633)	10.28 (0.573)	5.60 (0.523)	7.85 (0.802)
(8) Total factor productivity change[a]	2.04 (0.176)	3.71 (0.207)	1.33 (0.124)	0.48 (0.049)

[a]Ratio of weighted capital, labor, and material input as well as total factor productivity changes to gross output growth rates are given in parentheses.

Korea, 9 to 18 percent in Turkey, and 6 to 13 percent in Yugoslavia.[17] In Japan, Korea, and Turkey, there are really no 'slow growth' industries, and in Yugoslavia only two industries have growth rates under six percent a year.

Earlier, we noted that size of market may be an important factor in determining growth and productivity change. One way in which this scale effect comes about is through interindustry linkages. Balassa has argued that 'cost reductions tend to have a cumulative effect: improvements in particular industries are transmitted to other sectors through input–output relationships and through the effects of higher incomes on the demand for consumer goods'.[18] These intersectoral links, while also significant in developed countries, are especially important in developing countries which are undergoing major changes in input–output structure and in the composition of final demand as part of the process of development.[19] One important characteristic of the intermediate stage of development is that the share of intermediate demand in total gross production increases significantly over time. This trend would lead one to expect consistently higher output growth in the 'producer goods' sectors across all of the four countries. And, without prejudging causation, where one sees high growth rates, one also expects to see high TFP growth.

Although it is difficult to map our industry classification strictly into producer goods sectors, we can group the industries into the following four

[17]Note that the sample means of fig. 1 differ from aggregate manufacturing output growth in table 1 [row (1)], since the latter is computed as a weighted average.

[18]Balassa (1967, p. 97).

[19]Rapid structural change, especially if it also leads to sustained disequilibrium in the factor markets (i.e., different marginal producticities across sectors), also has a profound effect on aggregate growth. We will not pursue this issue further, but see for example Feder (1983), and Robinson (1971).

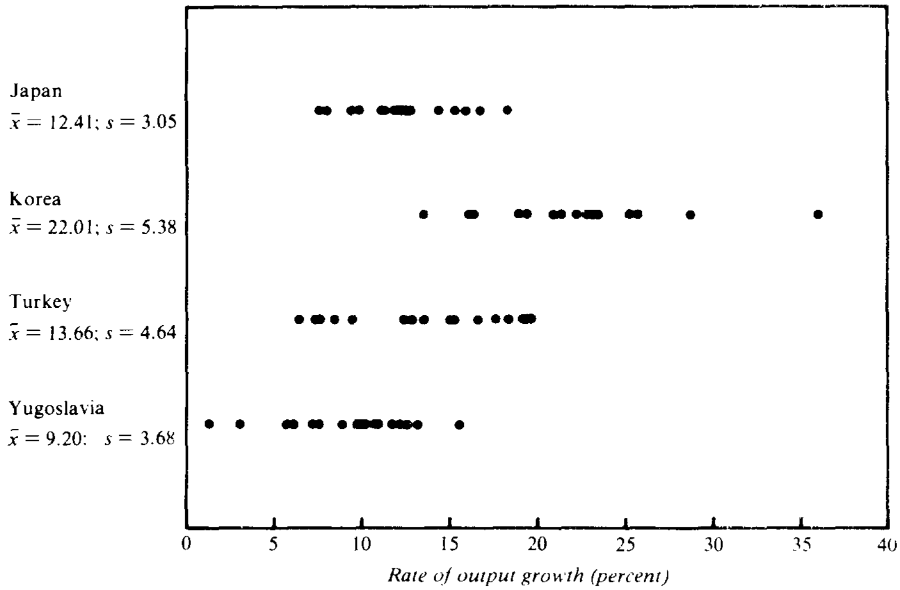

Fig. 1. Distribution of sectoral growth rates.

groups (as shown in table 2): (1) consumer goods, (2) light intermediates, (3) heavy intermediates, and (4) investment goods. We consider industry rankings within countries of both output and TFP growth. Using such rankings abstracts from country differences in the average growth rates. Table 2 presents these industry rankings, which are grouped in quartiles and then circled where there is a similar industry ranking in more than one country within each quartile. Table 3 summarizes the results further by giving a frequency count of industries in each ranking across countries within the four industrial groups.

The industry ranking of output and TFP growth arranged in this manner shows a strikingly similar pattern of faster growth in heavy industries and slower growth in light industries across the four countries. Investment goods industries are the fastest growing, followed by heavy intermediate goods industries and then the two light industry groups. Kendall's (multiple) rank correlation coefficient, which measures the similarity in rankings across all four countries together, is 0.75 for output growth excluding Yugoslavia (where the industry classification differs somewhat from the other three countries), and 0.52 when Yugoslavia is included. A similar but weaker correlation is observed in the industry ranking of TFP growth rates among the four countries. Similarly, a chi-square test treating table 3 as a contingency table yields values of 25.4 and 15.7 for the output growth and TFP growth tables. These values indicate a significant association between the

Table 2
Industry ranking of gross output and total factor productivity growth.
(Column key: *J* is Japan, *K* is Korea, *T* is Turkey, *Y* is Yugoslavia.)

	Gross output growth															
	Rank 1–4				Rank 5–8				Rank 9–12				Rank 13–16			
	J	*K*	*T*	*Y*	*J*	*K*	*T*	*Y*	*J*	*K*	*T*	*Y*	*J*	*K*	*T*	*Y*
Consumer goods																
(1) Food processing[a]													⑭	⑮	⑬	⑭
(2) Textile[b]											⑫	⑪	⑯	⑬		
(3) Apparel[b]			4		⑥	⑤						11				
(4) Leather		4						6	12						16	
Light intermediates																
(5) Lumber & wood[c]								7					⑮	⑭	⑮	
(6) Furniture[c]								7	⑩		⑪			16		
(7) Paper									⑫	⑪	⑨	⑨				
Heavy intermediates																
(8) Chemicals					⑧		⑦	⑤		9						
(9) Petroleum & coal[d]	4					⑦	⑥					10				
(10) Rubber			③	②						10			13			
(11) Stone clay & glass[c]					7					⑫	⑩					13
(12) Basic metals[f]		3					8		9							15
Investment goods																
(13) Fabricated metals[g]				3	⑤	⑧									14	
(14) Machinery[g]	③			③		⑥	⑤									
(15) Electrical machinery	①	①	②	①												
(16) Trans equipment[h]	②	②	①													16

	Output growth	TFP growth
Kendall's rank correlation coefficient (excluding Yugoslavia)	0.75	0.47
Significance level	(99.5%)	(75%)
Kendall's rank correlation coefficient (including Yugoslavia)	0.52	0.30
Significance level	(99%)	(75%)

Table 2 (continued)

	Total factor productivity growth															
	Rank 1–4				Rank 5–8				Rank 9–12				Rank 13–16			
	J	*K*	*T*	*Y*	*J*	*K*	*T*	*Y*	*J*	*K*	*T*	*Y*	*J*	*K*	*T*	*Y*
Consumer goods																
(1) Food processing[a]					5	6	5									16
(2) Textile[b]					8					11	9	9				
(3) Apparel[b]			4		6							9		15		
(4) Leather								8	12					13	15	
Light intermediates																
(5) Lumber & wood[c]						5			10						16	13
(6) Furniture[c]			3			8							14			13
(7) Paper								7	9	10	10					
Heavy intermediates																
(8) Chemicals	4						7	6		12						
(9) Petroleum & coal[d]								5					15	16	13	
(10) Rubber		3	1	1									16			
(11) Stone clay & glass[e]				2	7					9					14	
(12) Basic metals[f]									11		12			14		15
Investment goods																
(13) Fabricated metals[g]		2		3			8						13			
(14) Machinery[g]	2	4		3							11					
(15) Electrical machinery	1	1					6					11				
(16) Trans equipment[h]	3		2			7						11				

[a]Excluding Tobacco in Yugoslavia.
[b]Textile and Apparel are considered a tie ranking for Yugoslavia.
[c]Lumber & wood and Furniture are considered a tie ranking for Yugoslavia.
[d]Excluding coal for Yugoslavia.
[e]Average of Building materials and non-metallic minerals for Yugoslavia.
[f]Average of Ferrous and Non-ferrous metals for Yugoslavia.
[g]Fabricated metals and Machinery are considered a tie ranking for Yugoslavia.
[h]Shipbuilding only for Yugoslavia.

Table 3
Sectoral frequencies across countries of ranks of output and TFP growth.[a]

Aggregate sector	Gross output growth rank 1–4	5–8	9–12	13–16	Row sum
Consumer goods	2	3	4	7	16
Light intermediates	0	2	6	4	12
Heavy intermediates	4	7	6	3	20
Investment goods	10	4	0	2	16
Column sum	16	16	16	16	64

Aggregate sector	TFP growth rank 1–4	5–8	9–12	13–16	Row sum
Consumer goods	1	6	5	4	16
Light intermediates	1	3	4	4	12
Heavy intermediates	5	4	4	7	20
Investment goods	9	3	3	1	16
Column sum	16	16	16	16	64

[a]Consumer goods = sectors 1 to 4, Light intermediates = sectors 5 to 7, Heavy intermediates = sectors 8 to 12, Investment goods = sectors 13 to 16.

four industrial groups and rank according to both output and TFP growth, although the latter is significant at only the 90–95 percent confidence level.

Given these broad similarities, what are the major differences among the four countries? In particular, are there systematic differences in productivity performance by industries among the four countries? The country differences in TFP growth can be summarized statistically. For this purpose, we estimate a log-linear time-trend equation for TFP change over the individual industry's annual time series pooled across countries. The ordinary least squares regression (with standard errors given in parentheses) is

$$\begin{aligned}\ln \mathrm{TFP} = \underset{(0.0054)}{0.0085} + \underset{(0.0014)}{0.0194t} + \underset{(0.0020)}{0.0177Kt} - \underset{(0.0023)}{0.0105Tt} - \underset{(0.0020)}{0.0195Yt},\end{aligned}$$

$$R^2 = 0.475, \qquad \text{sample size} = 1054.$$

The variable t is time and the variables K, T, and Y are country dummies set to one for Korea, Turkey, and Yugoslavia, respectively, and zero otherwise. All estimated coefficients are significant at the 99 percent level, other than the intercept term (as should be expected since the level index of TFP is unity in the base year). These results indicate that sectoral TFP growth rates in Korea, Turkey and Yugoslavia differ significantly from Japan. In Korea, TFP growth is 1.77 percent above Japan, Turkey is 1.05 percent below Japan, and Yugoslavia is 1.95 percent below Japan. The difference in TFP growth rates is also statistically significant between Korea and Turkey, Korea and Yugoslavia, and Turkey and Yugoslavia. Furthermore, Yugoslavia's TFP growth rate is the only one which is not significantly different from zero.

Returning briefly to the aggregate manufacturing estimates in table 1, we note that these country differences in TFP growth reflect another marked difference in the manufacturing growth process of these four countries between the relative importance of TFP growth in output growth compared to factor input growth [see rows (5) through (8) in table 1]. Japan and Korea are similar in that TFP change is as important as capital and labor input growth combined.[20] For Turkey, although the rate of TFP growth is respectable, its contribution to output growth is significantly less important than that of capital and labor combined. In a sharp contrast, Yugoslavia's manufacturing growth involves very little TFP growth — virtually all growth is derived from increases in the quantity of inputs.

The relative importance of TFP growth on the one hand and capital and labor growth on the other at the disaggregated industry level can be examined in fig. 2. It plots the share of TFP growth in output growth against the share of capital plus labor growth in output growth in each industry by country from table A.2, with the 45-degree line indicating equal contributions. These industry results also show the contrast between Japan and Korea vs. Turkey and Yugoslavia noted above. In Turkey and Yugoslavia, the individual industry results mirror the aggregate pattern. In both countries, with only one exception, the contribution of sectoral TFP growth is less important than that of capital and labor input combined. In Yugoslavia, almost all industries derive their growth in output from increases in factor inputs, with zero or negative contribution from TFP growth.

The differences in productivity performance among countries might be at least partly caused by the nature of economic policies pursued by each country. One important dimension which distinguishes Japan, Korea, Turkey, and Yugoslavia from each other is their choice of trade policies in their development strategies. Korea and Yugoslavia (in that order) have manufacturing sectors which are relatively more open to trade, while Turkey and Japan are relatively more closed, the former by policy design and the latter mainly by the size of the domestic market. As we shall discuss in the next section, Korea's development strategy was distinguished by strong export promotion policies, often applied to selected industries. Turkey has

[20]Since the 'contribution' of material input growth to gross output growth is always the dominating factor in manufacturing, we shall focus on the relative importance of TFP, capital, and labor growth in our discussion.

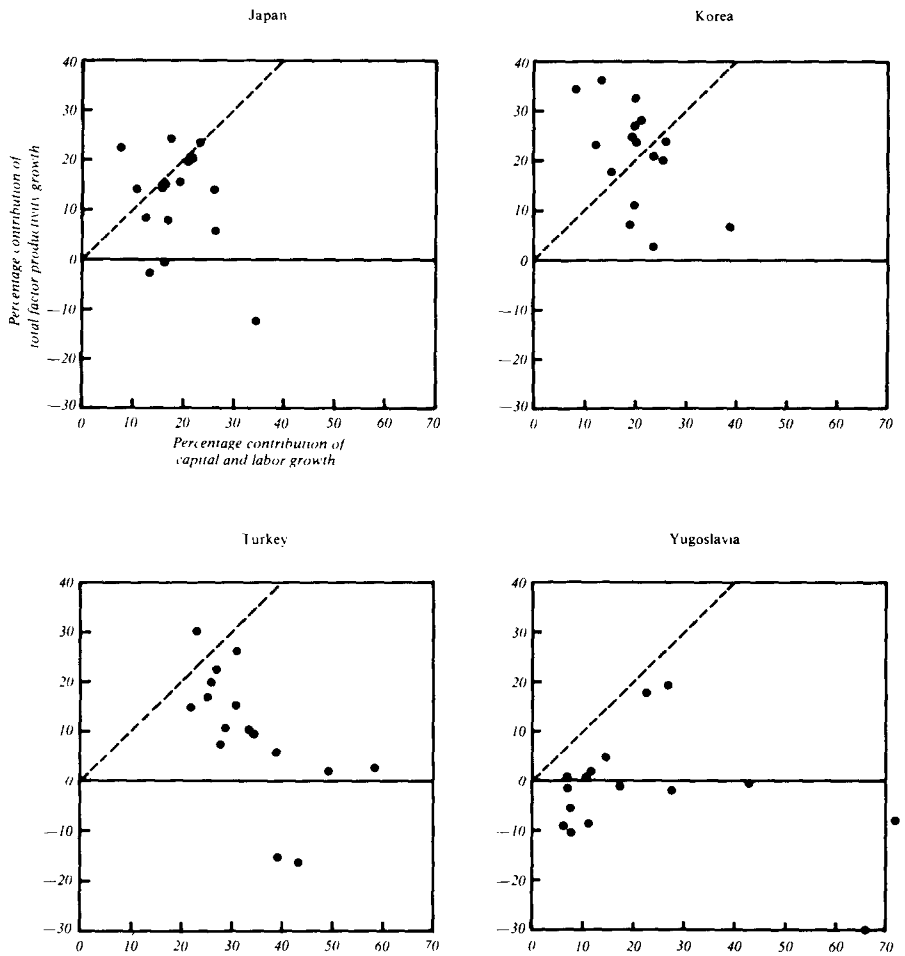

Fig. 2. Relative contributions of total factor productivity and primary inputs to growth of output for disaggregated industries.

long pursued import substitution policies across much of its manufacturing industries, many of which are dominated by state enterprises. Yugoslavia is distinguished by strong import liberalization accompanied by export expansion. In addition, it has long sought regional and sectoral equalization of productive performance with wage, employment, and investment policies designed to affect different industries similarly. Japan has made use of mixed export promotion and import substitution policies at different times. In the next section, we shall examine the relationship between growth and productivity performance of manufacturing industries, and the effect of the choice of an open, export-led development strategy versus a closed, import-substitution strategy.

4. Trade strategies and TFP growth

In the introduction, we discussed some hypotheses linking TFP growth and trade policies. The list of hypotheses includes: (1) a positive link between higher exports or (depending on the size of the domestic market) increased import substitution and TFP growth, arising from 'Verndoorn's law' and the role of export expansion and import substitution policies in increasing the size of the market, (2) a positive link between higher exports and TFP growth, and a negative (positive) link with import substitution (liberalization), arising from competitive cost-reducing incentives or lack thereof, and (3) a positive link between export expansion, import liberalization, and TFP growth, arising from the importance of foreign exchange constraints and non-substitutable imports of intermediate inputs and capital goods.

It is likely that one observes the net effect of all these hypotheses simultaneously. They are certainly not mutually exclusive, and distinguishing among them can be quite difficult. All these hypotheses can be seen as involving a supply response in terms of TFP change to changes in two components of demand: export expansion and import substitution. Taking these components as exogenous, or determined by exogenous policy regimes, we can then relate TFP growth to changes in the sources of demand growth. One must be very cautious, however, in implying the direction of causality in the relationship. For example, it may be that higher rates of exogenous TFP change lead to rapid growth in demand through lower costs and prices. Regardless of causality, however, the existence of any statistically significant relationship will provide an interesting starting point for further investigation.

The single equation model to be estimated is

$$TFPG=\beta_0+\beta_{\mathrm{EE}}x_{EE}+\beta_{\mathrm{IS}}x_{\mathrm{IS}}+\varepsilon,$$

where $TFPG$, x_{EE}, and x_{IS} are, respectively, annual rates of TFP growth, output growth allocated to export expansion, and output growth allocated to import substitution, and ε is the random disturbance term.[21]

[21]Strictly speaking, the model should also include output growth allocated to domestic demand growth. We found, however, high collinearity between export and domestic demand growth (whereas no such collinearity problem arose between import substitution and domestic demand), in most industries in all countries except Japan. It therefore becomes difficult to make a clear distinction between the effect of export vs. domestic demand statistically in these cases. Although we can sum the two growth rates, this imposes equality of coefficients between them. We choose instead to omit the domestic demand growth in the analysis below, although it may result in biased estimates particularly of export coefficients, and ask the readers to take care in interpreting our results.

For each industry in Japan, Korea, Turkey and Yugoslavia, we use as the dependent variable our estimate of annual rate of TFP change.[22] For the explanatory variables, we combine our estimates of annual output growth rates with demand-side sources of growth decomposition measures.[23] For each industry, total demand can be decomposed into the following components:

$$\Delta X = \hat{u}_t \Delta D + \hat{u}_t \Delta W + \Delta E + \Delta u(D_{t+1} + W_{t+1}),$$

where $\hat{u}$ is the diagonal matrix of domestic demand ratios (ratios of domestic demand to domestic plus import demand); D, W, and E are final demand, intermediate demand, and export demand, respectively; and the subscript refers to the time period.[24] The third and fourth terms in the decomposition give, respectively, the export expansion and import substitution components of demand changes. Dividing each of these two terms by ΔX, we obtain share measures of export expansion and import substitution in gross output changes for each industry in each country. We then multiply these share measures by annual growth rates of gross output of each industry.[25]

Table 4 provides a summary of the decomposition results at the aggregate level for the four countries. Note first that there is a great deal of variation in the relative roles of domestic demand expansion, export expansion, and import substitution, both over time and across countries. In every country, the role of export expansion increases over time — dramatically so in Korea and Yugoslavia — and in every country but Japan the role of import substitution decreases. Yugoslavia actually shows significantly import liberalization (i.e., negative import substitution). Korea and Turkey appear to have distinct phases, with a period characterized by significant import substitution followed by a period of export expansion — although the short export expansion phase in Turkey was hardly dramatic, especially compared to Korea. In Japan, although export expansion is significant in all three periods,

[22]Note that in this section we aggregate to thirteen industries (from those appearing in table 2) to achieve consistency among all countries with the data on demand components.

[23]See Kubo, Robinson and Syrquin (1981) for a description of the methodology. The data we use are described in Dervis, de Melo, and Robinson (1982, ch. 4).

[24]There is also a 'total' decomposition equation which uses the input–output matrix and therefore incorporates indirect linkages in the decomposition. Since we are concerned with the supply response of individual sectors to changes in demand, the direct decomposition equation is more appropriate for our purpose than the total decomposition measure. There is also an index-number problem arising from the choice of initial or terminal weights. We use an average of the analogous Paasche and Laspeyres indices.

[25]Since the share measures are based on data for a few benchmark periods, we apply the nearest shares to output growth rates for intervening years in the benchmark periods. The effect is to assume that the share measures reflect a regime that is uniform for each period. While clearly not ideal, this procedure does provide measures of the two explanatory variables. The benchmark periods for each country are as follows: Japan (1955–60, 1960–65, 1965–70), Korea (1963–70, 1970–73), Turkey (1963–68, 1968–73), and Yugoslavia (1966–72, 1972–78).

Table 4
Decomposition of growth of manufacturing demand (units: percent).

	Manufacturing		Growth decomposition[c]		
	Output[a] share	Growth[b] rate	Domestic demand expansion	Export expansion	Import substitution
Korea					
1955–63	32.1	10.4	64.3	7.2	28.5
1963–70	41.9	18.9	81.8	18.0	0.2
1970–73	49.6	23.8	62.9	38.1	−1.0
Turkey					
1953–63	27.9	6.4	90.6	1.3	8.1
1963–68	31.8	9.9	89.6	3.2	7.2
1968–73	36.5	9.4	94.2	6.7	−0.9
Yugoslavia					
1962–66	39.0	16.6	90.0	12.7	−2.7
1966–72	45.0	9.1	91.5	21.2	−12.7
Japan					
1955–60	47.2	12.6	95.4	5.8	−1.2
1960–65	50.4	10.8	90.2	9.9	−0.1
1965–70	54.6	16.5	92.1	8.1	−0.2

[a]Average share of manufacturing in aggregate gross output during the period.
[b]Average annual rate of growth of gross output.
[c]Decomposition methodology is described in the text. The three components sum to 100 percent. The first, domestic demand expansion, includes both intermediate and final demand.

the country is very large and the domestic market is the dominant component of demand. All in all, the sample of countries represents a variety of development experiences and, with the exception of Japan, they each underwent a significant shift in development strategy during the period under study. They should thus provide a good sample for statistical analysis.

Whether or not trade policies are tailored to particular industries, there is no *a priori* reason to expect that the manner in which they affect productivity performance is similar across different manufacturing industries. Applying covariance analyses to our panel data indicates that there are significant differences in the estimated regressions among industries in each country, and across countries in each industry. Therefore, we report a separate regression for each industry in each country in table 5.

The regressions reported in table 5 indicate that, overall, substantial portions of the variation in TFP growth rates are 'explained' by output growth allocated to export expansion and import substitution in Korea, Turkey and Yugoslavia, but (interestingly) not in Japan. There are also significant differences among manufacturing industries. In Korea, 13 percent to 83 percent of the variance in TFP change is 'explained' by the export

Table 5
Impact of export expansion and import substitution on total factor productivity changes; multiple regression results.[a]

Industry	Korea (1960–77) $\hat{\beta}_0$	$\hat{\beta}_{EE}$	$\hat{\beta}_{IS}$	R^2	DW	Turkey (1963–76) $\hat{\beta}_0$	$\hat{\beta}_{EE}$	$\hat{\beta}_{IS}$	R^2	DW
(1) Food processing	−0.030	11.164[b]	−1.212	0.352	2.042	−0.064[b]	6.416[b]	−9.917[b]	0.774	2.871
	(0.034)	(4.088)	(7.234)		(0.064)	(0.020)	(1.100)	(4.138)		(0.048)
(2) Textile & apparel	−0.005	0.224[b]	−1.437[b]	0.236	2.020	−0.008	0.665	−2.248	0.202	2.221
	(0.015)	(0.129)	(0.766)		(0.054)	(0.020)	(0.430)	(1.436)		(0.082)
(3) Leather	−0.088	1.305[b]	9.233	0.340	1.567	−0.059[b]	26.639[b]	−40.567[b]	0.821	(1.734)
	(0.053)	(0.541)	(7.042)		(0.132)	(0.023)	(10.643)	(13.711)		(0.066)
(4) Lumber & wood	0.003	0.518[c]	−0.729	0.402	2.579	0.009	8.539	−4.503	0.125	2.007
	(0.019)	(0.130)	(20.301)		(0.090)	(0.019)	(6.011)	(6.189)		(0.082)
(5) Paper	−0.042[b]	3.051[c]	−1.790[c]	0.835	1.997	−0.070	−3800.580[b]	163.570[b]	0.496	1.757
	(0.015)	(0.876)	(0.300)		(0.047)	(0.043)	(1291.160)	(54.911)		(0.110)
(6) Chemicals	−0.068[c]	1.729	5.096[c]	0.822	2.200	−0.069[c]	0.798	−10.198	0.741	2.929
	(0.018)	(2.795)	(1.334)		(0.044)	(0.018)	(55.418)	(9.707)		(0.032)
(7) Petro & coal	−0.161[b]	99.614[c]	−24.019[c]	0.568	1.419	−0.144[c]	373.362[b]	−852.478[b]	0.794	1.917
	(0.056)	(27.424)	(7.023)		(0.142)	(0.037)	(60.403)	(138.861)		(0.102)
(8) Rubber	−0.017	0.682[b]	3.582	0.421	2.033	−0.084[c]	134.499[b]	2.029[b]	0.952	2.018
	(0.034)	(0.303)	(18.995)		(0.078)	(0.018)	(21.511)	(0.144)		(0.040)
(9) Stone, clay & glass	−0.055	2.133[b]	6.651[b]	0.372	1.582	−0.067[b]	32.684[c]	−38.329[c]	0.643	1.601
	(0.041)	(1.232)	(2.344)		(0.077)	(0.021)	(7.702)	(9.463)		(0.044)
(10) Basic metals	0.016	0.241	−0.298	0.129	2.484	−0.068	36.644[c]	4.715[c]	0.843	(1.724)
	(0.021)	(0.333)	(0.516)		(0.049)	(0.038)	(5.522)	(0.868)		(0.064)
(11) Fabricated metals	0.029	0.483[b]	0.019	0.136	1.999	−0.005	13.165[b]	0.109	0.224	2.308
& machinery	(0.020)	(0.265)	(0.335)		(0.088)	(0.018)	(5.197)	(0.674)		(0.072)
(12) Electrical machinery	−0.024	0.375	−0.614[b]	0.320	1.870	−0.000	30.900[c]	−2.022	0.621	2.952
	(0.044)	(0.253)	(0.324)		(0.089)	(0.027)	(7.856)	(1.366)		(0.054)
(13) Transportation equipment	−0.012	0.314	3.475[b]	0.439	1.705	−0.017	221.755[c]	0.471[b]	0.560	1.629
	(0.025)	(0.243)	(1.175)		(0.068)	(0.022)	(67.220)	(0.221)		(0.060)

Table 5 (continued)

Industry	Yugoslavia (1965–78)					Japan (1955–73)				
	$\hat{\beta}_0$	$\hat{\beta}_{EE}$	$\hat{\beta}_{IS}$	R^2	DW	$\hat{\beta}_0$	$\hat{\beta}_{EE}$	$\hat{\beta}_{IS}$	R^2	DW
(1) Food processing	−0.024[c]	0.703[c]	0.056	0.605	2.201	−0.013	13.740	−4.534	0.189	(1.441)
	(0.007)	(0.233)	(1.128)		(0.036)	(0.023)	(12.796)	(3.318)		(0.030)
(2) Textile & apparel	−0.011[b]	0.478[b]	0.170	0.387	(1.738	0.036[b]	6.399[b]	−3.291	0.408	(1.685)
	(0.004)	(0.190)	(0.265)		(0.008)	(0.017)	(2.491)	(3.680)		(0.061)
(3) Leather	−0.005	0.081	−0.625	0.449	2.004	0.000	0.543	−1.252	0.023	1.631
	(0.007)	(0.161)	(0.575)		(0.016)	(0.023)	(3.349)	(3.550)		(0.046)
(4) Lumber & wood	−0.012	0.493	0.139	0.108	2.040	−0.008	7.026	−1.848	0.045	2.219
	(0.007)	(0.475)	(0.713)		(0.016)	(0.016)	(5.649)	(3.085)		(0.046)
(5) Paper	−0.009	−1.186	−1.988	0.169	1.900	−0.001	4.341	−8.659	0.034	1.982
	(0.009)	(1.271)	(1.600)		(0.021)	(0.026)	(6.262)	(14.770)		(0.040)
(6) Chemicals	−0.001	−0.124	−0.264	0.032	1.396	−0.018	4.127[b]	−2.351	0.187	1.920
	(0.013)	(0.864)	(0.664)		(0.027)	(0.024)	(2.245)	(1.626)		(0.036)
(7) Petro & coal	0.002	−0.748[b]	−0.199[b]	0.226	1.777	−0.002	1.411	−2.039	0.094	1.643
	(0.009)	(0.288)	(0.080)		(0.044)	(0.011)	(2.173)	(1.959)		(0.029)
(8) Rubber	−0.013	2.522[c]	0.138	0.772	2.775	−0.018	−0.070	−18.812	0.037	2.016
	(0.008)	(0.465)	(0.154)		(0.017)	(0.017)	(0.678)	(24.831)		(0.043)
(9) Stone, clay & glass	−0.005	2.005[c]	−0.805[b]	0.576	1.806	0.010	1.673	−5.265	0.106	1.779
	(0.004)	(0.364)	(0.289)		(0.018)	(0.008)	(1.492)	(18.631)		(0.027)
(10) Basic metals	−0.008	0.004	−0.100	0.222	(1.707)	0.021	−1.316	4.593	0.102	1.489
	(0.006)	(0.109)	(0.131)		(0.021)	(0.022)	(1.970)	(3.537)		(0.061)
(11) Fabricated metals	−0.013[b]	1.119[c]	0.052	0.700	1.855	0.003	1.352	−0.671	0.076	1.799
& machinery	(0.004)	(0.233)	(0.079)		(0.007)	(0.012)	(0.875)	(2.517)		(0.046)
(12) Electrical machinery	−0.011	2.222[c]	−9.051[b]	0.515	1.783	0.048[c]	0.205	−7.185[b]	0.213	2.146
	(0.010)	(0.682)	(3.106)		(0.018)	(0.011)	(0.554)	(3.765)		(0.021)
(13) Transporatation equipment	−0.030[b]	−0.048	14.654[c]	0.929	(1.883)	0.027[b]	−0.214	3.501	0.158	1.974
	(0.012)	(0.044)	(1.604)		(0.029)	(0.010)	(0.377)	(2.145)		(0.017)

[a]Regression equation: $TFPG = \beta_0 + \beta_{EE}\chi_{EE} + \beta_{IS}\chi_{IS} + \varepsilon$, estimated using annual data over the period indicated in parentheses for each country. Standard errors of coefficients are reported in parentheses below each coefficient. Standard errors of estimates are reported in parentheses below Durbin–Watson statistics. Durbin–Watson statistics in parentheses indicate that Cochrane–Orcutt correction was applied.

[b]Significantly different from zero at the 90% level.

[c]Significantly different from zero at the 99% level.

expansion and import substitution growth rates in gross output. Only three industries show less than 30 percent of the variance explained. In Turkey, the range is 13 percent to 95 percent, with only three industries below 30 percent. In Yugoslavia, the low is 3 percent and the high 93 percent, with four industries below 30 percent. In Japan, on the other hand, the range is 2 percent to 41 percent, with all industries other than textiles and apparel showing less than 30 percent of variance in TFP change explained. Note also in table 5 that all the statistically significant constant terms ($\hat{\beta}_0$) for Korea, Turkey and Yugoslavia are negative, while they are all positive for Japan. Negative constant terms in the three countries imply reductions in TFP levels (i.e., increases in unit cost of production), unless offset by sufficiently positive contributions from the growth in output due to export expansion and/or import substitution. These striking contrasts between Korea, Turkey and Yugoslavia, on the one hand, and Japan on the other points to the relative importance of trade and trade policies in the three developing countries. The results are also consistent with the view that domestic demand has been the prime source of growth in Japan.

We also observe in table 5 that the estimated elasticities of TFP change with respect to export expansion and import substitution growth rates are distinctly larger (in absolute values) in Turkey compared with the other countries. Furthermore in Turkey, in all industries except paper products, the elasticities with respect to export expansion are greater than those with respect to import substitution. Turkey is probably the most closed economy among the four countries, and these results emphasize the importance of trade at the margin for such an economy.[26]

Table 6 presents a summary of the regression results, indicating only the signs of the statistically significant estimated coefficients, and also provides an indication of export-oriented and import-competing industries in each country. Export-oriented industries are defined as those with exports greater than 10 percent of total production and import-competing industries as those with imports greater than 10 percent of total domestic supply. Table 6 also gives aggregate export and import shares to indicate the relative 'openness' of the manufacturing sector in these countries.

The summary table reveals some interesting results which are difficult to observe in table 5. Of the 28 cases where statistically significant elasticities with respect to export expansion are estimated, only two are negative. In contrast, 13 out of 21 significant elasticities with respect to import substitution are negative. Import substitution regimes thus seem to be negatively correlated with TFP change, whereas export expansion regimes are positively correlated with TFP change. In Korea, no industry 'suffers' from export expansion, and those industries that 'benefit' from it are concentrated in light manufacturing and heavy-intermediate industries. In Turkey, the concent-

[26]See Celasun (1983) for an analysis of the structure of Turkish growth during the period.

Table 6
Summary of regression results.[a]

Industry	Export expansion				Import substitution			
	Korea	Turkey	Yugoslavia	Japan	Korea	Turkey	Yugoslavia	Japan
(1) Food processing	+	+	+			–	–	MC
(2) Textiles & apparel	+EO		+EO	+EO	–MC		MC	
(3) Leather	+EO	+	EO			–		
(4) Lumber & wood	+EO		EO					
(5) Paper	+	–			–MC	+	MC	
(6) Chemicals			EO	+	+MC	MC	MC	
(7) Petroleum & coal	+	+	–		–	–	–MC	
(8) Rubber	+EO	+	+	EO		+	MC	
(9) Stone, clay & glass	+EO	+	+EO		+	–	–MC	
(10) Basic metals	EO	+	EO		MC	+MC	MC	
(11) Fabricated metals & machinery	+EO	+	+EO		MC	MC	MC	
(12) Electrical machinery		+	+EO		–MC	MC	–MC	
(13) Transportation equipment		+	EO	EO	+MC	+MC	+MC	
(14) Total manufacturing share of exports in production	0.254	0.037	0.164	0.081				
(15) Total manufacturing share of imports in domestic supply					0.278	0.112	0.237	0.044

[a]+ and – indicate the sign of statistically significant coefficients in the regression estimates in table 5. EO is export-oriented industry (exports greater than 10% of total production), MC is import-competing industry (imports greater than 10% of total domestic supply, i.e., imports plus total production less exports). The export and import shares were computed for 1973 in Korea and Turkey, 1972 in Yugoslavia and 1970 in Japan.

ration shifts down towards all heavy industries. Yugoslavia shows no clear pattern of concentration. Paper products in Turkey and petroleum and coal products in Yugoslavia are the only two industries that show an adverse impact on productivity from export expansion. In Japan, only two industries benefit significantly from export expansion. Industries that experience a significant impact from import substitution are concentrated in Turkey and Korea. More of these are heavy industries in Turkey compared with Korea. Only four industries in Yugoslavia and one in Japan show a significant impact from import substitution.

These results support some of the hypotheses outlined above and raise new hypotheses that are worth examining in future work. First, the results do not support the simple version of 'Verdoorn's law' which implies that any expansion of the market, regardless of source, should improve productivity performance. There are significant and strong differences in the impact of export expansion versus import substitution. Second, the results are consistent with the hypothesis that export expansion leads to higher TFP growth, through economies of scale and/or through competitive incentives. Third, the results are also consistent with the converse hypothesis that increased import substitution (import liberalization) leads to lower (higher) TFP growth, perhaps through reducing (increasing) competitive cost-reduction incentives. Finally, the results are also consistent with the hypothesis that export expansion and import liberalization increase TFP growth through relaxing the foreign exchange contraint and imports of non-substitutable intermediate and capital goods.

The results provide some interesting material for debates on infant industry protection policies. In every case but one in Korea and Yugoslavia, and in every case in Turkey, sectors with a statistically significant negative impact of import substitution on *TFP* growth are also sectors with a significant positive impact of export expansion. Westphal (1981) has recently revived the infant-industry argument for selective protection by noting a strong link at the micro level between protection and export performance. He concludes (p. 35) that he has identified '... one possible reason why the industrial sector in a country like Korea, following an outward-looking strategy, performs so well; namely, the possibility that its selectively promoted infant industries exhibit superior performance as a result of their export activity'. Our results for Korea are certainly consistent with this argument.[27]

Krueger and Tuncer (1982) consider the standard infant industry argument in Turkey, and conclude (p. 1149): '... input per unit of output must fall

[27]One should note, however, that our results may at least partly reflect aggregation problems. Within any one of our 'sectors', exports and import substitutes may be very different products. We once again remind the readers of the collinearity issue discussed in footnote 21, and to exercise care in interpreting our discussion on 'export expansion', since the estimates may be biased in part to reflect the domestic demand effect.

more rapidly in more protected industries if there is to be any rationale for infant industry protection. In the Turkish case, there was no such tendency over the period covered'. In Turkey, in contrast to Korea, the export expansion phase was very short and not that strong. It can be stated, therefore, that the positive impact of export expansion on TFP growth which we found did not offset the negative impact of import substitution. Our results are thus consistent with those of Krueger and Tuncer, but we would be more diffident in concluding that protection was not justified. The positive relationship between TFP growth and export performance in Turkey indicates the possibility that they could have followed the Korean example of selective protection, with export performance providing a test of success. Indeed, they still might do so.

One final point is worth noting. In both Korea and Turkey, an import substitution phase was followed by a phase with significant export contribution to growth. While the Turkish export phase from 1970–73 turned out to be abortive, largely because the government allowed incentives to move against exports, the country is currently entering a new period of rapid and successful export promotion. The observed phasing leads naturally to the hypothesis that a period of protected import substitution is useful — perhaps even necessary — to build a base from which a successful export drive, with associated positive TFP growth, can be launched.[28] Westphal's argument holds out the hope that the benefits of export expansion on TFP growth can be realized simultaneously with the protection phase, but only if the incentives are tied to export performance. Such was not the case in Turkey, nor was there such an intention on the part of the policy makers. However, the question of whether a period of protected import substitution, with associated negative impact on TFP growth, is 'worth' the costs is not so easily answered. The crucial policy question is that of timing. How long must one wait for an infant to mature? And is it possible to devise a policy mix that hastens the maturation process by tying policy incentives to performance (especially exports)?

5. Conclusion

The results we have presented have raised as many questions as they have answered. At this stage in productivity research, such a state of affairs is probably desirable. There is a real need to coordinate research at the micro and 'sectoral' and/or aggregate levels. The sorts of 'stylized facts' that we are considering must be tested against work at the micro level to see if the stylization makes sense. Similarly, the micro work must be tested against comparative data at more aggregate levels to see what sorts of generalizations are reasonable.

[28]See also Kubo and Robinson (1979) who present data on such phasing in other countries. See also Balassa (1979).

There are also unresolved questions about the interdependence of different policies. A 'development strategy' implies a coordinated effort to devise a consistent set of policies in a number of areas. By definition, such a strategy has effects on a large part of total economic activity in a country. The existence of linkages and externalities implies that it will be difficult if not impossible to consider the impact of such strategies in a partial-equilibrium framework. The work to date indicates that the relationships between different development strategies and TFP growth are very important, if not crucial, to gaining an understanding of what makes a 'successful' development strategy.

Appendix

Table A.1
Output, input and total factor productivity growth by industry (in percent per year).[a]

Industry	Japan (1955–73) (1)	(2)	(3)	(4)	(5)	Korea (1960–77) (1)	(2)	(3)	(4)	(5)	Yugoslav industry
(1) Food processing	9.36	9.96	3.22	7.11	2.21	16.09	8.50	4.49	13.24	5.26	(1) Food processing
											(2) Tobacco
(2) Textile	7.49	5.98	1.42	7.06	1.70	18.88	13.09	6.68	16.40	4.51	(3) Textile & apparel
(3) Apparel	12.52	16.23	6.48	11.28	1.94	23.34	22.11	12.75	22.98	1.62	
(4) Leather	11.15	8.45	5.09	11.63	0.95	25.20	14.78	18.91	25.46	2.80	(4) Leather
(5) Lumber & wood	7.94	7.45	1.98	7.88	1.12	16.32	5.56	4.89	13.00	5.62	(5) Lumber & wood, furniture
(6) Furniture	11.83	9.65	4.97	14.73	−0.09	13.49	4.93	3.74	11.90	4.88	
(7) Paper	11.25	10.75	4.96	10.38	1.62	19.41	6.73	7.61	19.37	4.52	(6) Paper
(8) Chemicals	12.23	10.86	2.38	10.73	2.50	21.33	14.42	5.93	19.46	4.49	(7) Chemicals
(9) Petroleum & coal	15.28	13.58	3.31	16.69	−0.43	22.81	20.40	2.24	24.06	0.68	(8) Petroleum
											(9) Coal
(10) Rubber	9.79	14.08	5.14	11.71	−1.22	20.90	16.80	11.02	15.44	5.88	(10) Rubber
(11) Stone, clay & glass	12.43	13.22	4.30	12.30	1.73	18.93	11.12	7.20	18.73	4.33	(11) Building materials
											(12) Non-metallic minerals
(12) Basic metals	12.11	13.08	4.50	11.85	0.96	25.68	25.58	4.90	25.52	1.87	(13) Ferrous metals
											(14) Non-ferrous metals
(13) Fabricated metals	14.33	16.35	7.30	15.20	0.84	22.19	12.49	10.17	19.01	6.01	(15) Metal products
(14) Machinery	15.90	13.87	6.12	14.56	3.14	23.01	13.31	7.88	21.91	5.73	
(15) Electrical machinery	18.26	12.20	7.68	15.72	4.42	36.00	25.87	17.48	31.88	7.25	(16) Electrical machinery
(16) Transportation equipment	16.69	13.27	6.25	15.89	2.53	28.68	13.64	8.66	30.76	5.10	(17) Shipbuilding

Table A.1 (continued)

Industry	Turkey (1963–76) (1)	(2)	(3)	(4)	(5)	Yugoslavia (1965–78) (1)	(2)	(3)	(4)	(5)	Yugoslav industry
(1) Food processing	8.47	8.30	3.39	6.40	1.91	7.20	7.28	4.55	8.24	−0.65	(1) Food processing
						5.74	7.47	−2.04	13.89	−1.71	(2) Tobacco
(2) Textile	9.47	10.88	3.35	8.09	1.44	9.77	7.78	3.50	12.87	−0.17	(3) Textile & apparel
(3) Apparel	18.30	14.80	8.46	17.63	2.74						
(4) Leather	6.41	16.39	3.25	6.41	−0.98	11.69	8.21	5.29	15.45	−0.14	(4) Leather
(5) Lumber & wood	7.35	11.28	4.92	8.39	−1.20	10.85	7.89	1.94	15.45	−0.60	(5) Lumber & wood, furniture
(6) Furniture	12.37	19.13	4.34	9.28	3.23						
(7) Paper	13.53	12.34	4.24	13.93	1.41	10.77	7.18	3.64	13.01	0.07	(6) Paper
(8) Chemicals	15.23	12.13	7.65	15.55	1.62	12.14	8.19	4.15	14.06	0.10	(7) Chemicals
(9) Petroleum & coal	16.60	17.68	−0.81	14.99	0.45	10.09	9.32	1.02	12.72	0.18	(8) Petroleum
						1.32	6.40	−2.91	5.05	1.10	(9) Coal
(10) Rubber	19.19	13.29	3.59	15.85	5.80	13.19	10.74	5.36	17.55	2.35	(10) Rubber
(11) Stone, clay & glass	12.80	13.91	7.05	13.66	0.26	9.90	8.05	1.94	13.70	−0.05	(11) Building materials
						8.90	6.99	2.08	12.64	1.72	(12) Non-metallic minerals
(12) Basic metals	14.98	14.52	11.41	14.62	0.87	6.08	6.85	0.37	7.84	−0.63	(13) Ferrous metals
						7.54	8.00	1.13	9.85	−0.65	(14) Non-ferrous metals
(13) Fabricated metals	7.57	9.68	−0.88	6.55	1.51	12.58	7.35	4.18	16.31	0.60	(15) Metal products
(14) Machinery	17.61	13.64	13.97	17.81	1.33						
(15) Electrical machinery	19.34	19.44	10.99	17.76	1.83	15.55	10.78	4.28	19.29	−0.25	(16) Electrical machinery
(16) Transportation equipment	19.48	16.05	7.51	19.65	3.33	3.09	6.52	1.35	5.21	−0.25	(17) Shipbuilding

[a]*Columns*: (1) Gross output growth, (2) Capital input growth, (3) Labour input growth, (4) Material input growth, (5) Total factor productivity growth.

Table A.2

Sources of growth by industry (in percent).[a]

Industry	Japan (1955–73)				Korea (1960–77)				Yugoslav industry
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	
(1) Food processing	23.5	19.7	3.7	52.9	32.6	17.9	2.1	47.2	(1) Food processing
									(2) Tobacco
(2) Textile	22.6	4.9	2.8	69.5	23.8	16.3	3.8	55.9	(3) Textile & apparel
(3) Apparel	15.5	9.2	10.2	65.0	6.9	21.7	17.1	64.1	
(4) Leather	8.5	4.7	8.0	78.6	11.1	11.8	8.0	68.9	(4) Leather
(5) Lumber & wood	14.1	6.8	4.0	74.9	34.4	6.5	1.8	57.2	(5) Lumber & wood, furniture
(6) Furniture	−0.7	4.9	11.4	84.3	36.1	8.3	5.1	50.3	
(7) Paper	14.4	9.2	6.7	69.5	23.3	8.8	3.4	64.3	(6) Paper
(8) Chemicals	20.4	19.6	2.4	57.3	21.0	21.1	2.5	55.3	(7) Chemicals
(9) Petroleum & coal	−2.7	12.4	1.0	89.3	2.9	22.8	0.9	73.1	(8) Petroleum
									(9) Coal
(10) Rubber	−12.4	27.2	7.4	77.7	28.1	14.8	6.5	50.4	(10) Rubber
(11) Stone, clay & glass	13.9	18.1	8.1	59.7	23.9	21.1	5.0	49.9	(11) Building materials
									(12) Non-metallic minerals
(12) Basic metals	7.9	12.8	4.3	74.9	7.2	18.1	0.9	73.6	(13) Ferrous metals
									(14) Non-ferrous metals
(13) Fabricated metals	5.8	14.7	11.8	67.5	27.0	13.3	6.5	53.0	(15) Metal products
(14) Machinery	19.7	12.4	8.7	59.0	24.9	14.1	5.3	55.5	
(15) Electrical machinery	24.2	10.1	7.6	57.9	20.1	19.9	5.6	54.1	(16) Electrical machinery
(16) Transportation equipment	15.1	10.3	6.1	68.3	17.7	11.5	3.8	66.9	(17) Shipbuilding

Table A.2 (continued)

Industry	Turkey (1963–76) (1)	(2)	(3)	(4)	Yugoslavia (1965–78) (1)	(2)	(3)	(4)	Yugoslav industry
(1) Food processing	22.6	24.1	3.0	50.2	−9.0	1.7	4.5	102.8	(1) Food processing
					−29.8	69.8	−3.8	63.8	(2) Tobacco
(2) Textile	15.2	26.1	4.9	53.7	−1.7	20.9	6.6	74.1	(3) Textile & apparel
(3) Apparel	14.9	13.8	8.2	62.9					
(4) Leather	−15.2	34.6	4.6	76.0	−1.1	3.3	14.0	83.7	(4) Leather
(5) Lumber & wood	−16.2	33.7	9.5	72.9	−5.5	2.1	5.5	97.8	(5) Lumber & wood, furniture
(6) Furniture	26.1	35.2	−4.1	28.2					
(7) Paper	10.4	28.2	5.3	55.9	0.6	3.4	7.2	88.7	(6) Paper
(8) Chemicals	10.6	22.8	6.1	60.4	0.8	0.0	6.9	92.2	(7) Chemicals
(9) Petroleum & coal	2.7	58.5	−0.1	38.9	1.8	11.5	0.1	86.5	(8) Petroleum
					82.8	63.6	−138.3	91.8	(9) Coal
(10) Rubber	30.2	21.3	1.8	46.5	17.7	0.0	22.5	59.7	(10) Rubber
(11) Stone, clay & glass	2.0	38.8	10.4	48.6	−0.4	41.0	1.8	57.5	(11) Building materials
					19.3	17.4	9.4	53.6	(12) Non-metallic minerals
(12) Basic metals	5.8	30.1	8.9	55.1	−10.4	7.2	0.4	102.6	(13) Ferrous metals
					−8.6	9.2	1.9	97.4	(14) Non-ferrous metals
(13) Fabricated metals	19.9	28.2	−2.2	54.1	4.8	3.8	10.7	80.6	(15) Metal products
(14) Machinery	7.5	18.2	9.6	64.5					
(15) Electrical machinery	9.4	26.6	7.8	56.1	−1.5	2.0	5.0	94.4	(16) Electrical machinery
(16) Transportation equipment	17.0	17.8	7.4	57.6	−7.9	47.3	24.6	35.6	(17) Shipbuilding

[a]*Columns*: (1) Total factor productivity growth/gross output growth, (2) Capital input growth/gross output growth, (3) Labour input growth/gross output growth, (4) Material input growth/gross output growth.

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